CLAIMS:

We claim:

1.     A device comprising:

a digital signal processor that is configured to convert a plurality of voice signals into voice packets, the digital signal processor having a voice activity detector that is configured to monitor the plurality of voice signals; and

a packet transmitter having a subcell multiplexing unit configured to adaptively adjust a maximum delay time experienced by a voice packet based upon a state change of the voice activity detector.

2.     The device of claim 1, wherein the subcell multiplexing unit comprises:

a connection admission controller configured to monitor a packet length and a packet rate for each of the plurality of voice signals and configured to signal the packet transmitter when a change in the packet length and the packet rate occurs.

3.     The device of claim 2, wherein the packet transmitter is configured to adjust the maximum delay time based upon the change in the packet length and the packet rate.

4.     The device of claim 3, wherein a new maximum delay time is calculated based upon the following formula:

$$D_{max(new)} = \frac{1}{\left[ \dfrac{1}{D_{max(old)}} + \dfrac{\left( P_{new} R_{new} - P_{old} R_{old} \right)}{47*1000} \right]} \, m \sec$$

where $P_{old}$ and $P_{new}$ represent an old and a new packet length, respectively, where $R_{old}$ and $R_{new}$ represent an old and a new packet rate, respectively, and where $D_{max(old)}$ represents an old maximum delay value.

5.     The device of claim 1, the subcell multiplexing unit configured to multiplex a voice packet containing a specialized signaling packet immediately, without regard to the maximum delay time.

6.     The device of claim 1, wherein the voice packets are configured to be transmitted over a network chosen from the group consisting of an asynchronous transfer mode network, an X.25 protocol network, and a frame relay network.

7.     A voice over packet gateway comprising:

a digital signal processor configured to generate a plurality of voice packets, each voice packet containing a channel identifier indicating one of a plurality of active calls from which the each voice packet was derived;

a voice activity detector configured to monitor the plurality of active calls and cause the digital signal processor to generate silence indication packets when any of the plurality of active calls drops below a signal threshold level;

a subcell multiplexing unit configured to multiplex an ATM cell that is only partially filled with voice packets into a virtual circuit after a timer value expires; and

a control module configured to adjust the timer value based upon a frequency at which the silence indication packets are received by the subcell multiplexing unit.

8.     The gateway of claim 7, the control module further configured to adjust the timer value based upon the number of times that a voice packet is multiplexed during a unit time period.

9.     The gateway of claim 8, the control module further configured to adjust the timer value based upon a bandwidth wastage factor of the ATM cells.

10.     The gateway of claim 7, the control module further configured to adjust the timer value based upon a frequency that silence indication packets are generated by the digital signal processor.

11.     The gateway of claim 7, the control module further configured to maintain the timer value at a level no greater than a maximum delay experienced by a voice packet.

12.    The gateway of claim 11, wherein the maximum delay is calculated from the following equation:

$$D_{MAX} = \left[ \frac{47*1000}{\sum_{i=1}^{N}(P_i R_i)} \right] m\sec$$

where N is the number of active calls on the virtual circuit, $P_i$ is the packet length of the i$^{th}$ active call in units of bytes, and $R_i$ is the packet rate of the i$^{th}$ active call in units of packets per second.

13.    The gateway of claim 12, wherein the maximum delay is recalculated upon occurrence of an event chosen from the group consisting of a deletion of an active call from the virtual circuit, an addition of an active call to the virtual circuit, and an upspeed/downspeed adjustment in an active call.

14.    The gateway of claim 7, wherein the subcell multiplexing unit is further configured to detect a signaling packet in the payload of a voice packet and forward the signaling packet without regard to the timer value.

15.    A method comprising adaptively adjusting a default timer value in a subcell multiplexer to optimize a delay experienced by a voice packet in response to a voice traffic condition.

16.    The method of claim 15, wherein adaptively adjusting the default timer value comprises:

    monitoring a packet rate and a packet length of a plurality of voice calls; and

    calculating a maximum delay experienced by the partially filled voice packet based upon a change in the packet rate and the packet length.

17.    The method of claim 16, wherein calculating the maximum delay comprises:

calculating the maximum delay with the following formula,

$$D_{max(new)} = \frac{1}{\left[\frac{1}{D_{max(old)}} + \frac{(P_{new}R_{new} - P_{old}R_{old})}{47*1000}\right]} \, m \sec$$

where $P_{old}$ and $P_{new}$ represent an old and a new packet length, respectively, where $R_{old}$ and $R_{new}$ represent an old and a new packet rate, respectively, and where $D_{max(old)}$ represents an old maximum delay value.

18.    The method of claim 16, wherein adaptively adjusting the default timer value further comprises setting the default timer value to be no greater than the maximum delay.

19.    The method of claim 15, further comprising:

differentiating between a voice packet and a signaling packet that is generated along with the voice packet; and

forwarding the ATM cell, even if it is partially filled, immediately upon receiving the signaling packet among the voice packets.

20.    The method of claim 19, wherein the signaling packet is a Type 3 packet used in VoAAL2 subcell multiplexing.